

ASTEROZOA FROM AMSTERDAM AND ST PAUL ISLANDS, SOUTHERN INDIAN OCEAN

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SYNOPSIS

Asteroids and ophiuroids collected recently around Amsterdam and St Paul Islands by French scientific collectors in association with lobster fishing vessels are reported. One new species of asteroid, a goniasterid named *Sphaeriodiscus mirabilis*, is described and the systematic position of another asteroid, named *Culcita veneris* by Perrier (1879) but now confirmed as better placed in *Spoladaster*, is discussed at some length with comments on related Poraniidae. Besides a third asteroid and one ophiuroid species previously recorded, four other ophiuroids new to these islands are also found to occur there.

INTRODUCTION

THE interesting collection of Asterozoa which forms the basis for this report was sent to the British Museum by Dr P. M. Arnaud of the Station Marine d'Endoume in Marseille. The material was primarily collected by Dr J. Beurois in 1971-72 but a few additional specimens originated from P. M. Arnaud, P. Noel, R. Vranckx, M. Segonzac and the fishing vessel *Maria Martina*.

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Hitherto the only published records of Asterozoa from these remote islands in the Indian Ocean (c. 38°S, 77½°E) were based on material from two sources. Firstly the French Transit of Venus Expedition, 1874-75 (naturalist C. Vélain), from which two asteroids, named as *Asterina exigua* (Lamarck) and *Culcita veneris* sp. nov., were reported by Perrier (1879). Secondly the German South Polar (*Gauss*) Expedition of 1901-3, which evidently took only the first asteroid, recorded as *Patiriella exigua* by Döderlein (1927), and one ophiuroid, recorded as *Amphipholis minor* by Hertz (1927). Darnall (1971) confirmed that the *Gauss* asteroids are conspecific with *Patiriella exigua* (Lamarck) from South Africa and temperate Australia, when he split off tropical records of *P. exigua* as a distinct species. In contrast, Perrier's second asteroid and the new species now described appear to be endemic to these isolated islands.

Thanks to offshore work by lobster fishing vessels on the shelf around these islands to a depth of about 300 m and to painstaking collecting from washings of encrusting organisms, one fine new species of goniasterid starfish and four additional species of ophiuroids are included in the present material. Unfortunately most of the ophiuroids are very small and not in good condition and one amphiuroid is not

identifiable to species. However, the other three indicate an affinity with the ophiuroid fauna of south and south-east Africa in similar latitudes up-current in the West Wind Drift. This accords with the distribution of some other benthic invertebrates.

DESCRIPTION OF SPECIES

ASTEROIDEA

Sphaeriodiscus mirabilis sp. nov.

(Pls 1 and 2)

MATERIAL. Vicinity of St Paul and Amsterdam Islands at 200–300 metres, fishing vessel *Maria Martina*, 1971, the holotype, B.M. reg. no. 1976.1.12.1.

DESCRIPTION. R/r 70/45 mm = 1.56/1. The breadth of the swollen arm tip is c. 26 mm.

The area of abactinal plates is almost pentagonal. After preservation in spirit it is sunken below the raised rim of the superomarginal plates. Distally the abactinal plates are hexagonal and fairly regular in arrangement in longitudinal and diagonal series but interstitial plates are found proximally to about two-thirds R from the centre and as these become larger and more numerous towards the centre the regular arrangement is lost. A mid-radial row of plates is just discernible, though proximally its constituent plates are all separated. Conversely the plates of the interradial rows are nearly all contiguous.

All the plates are flat-topped and covered with a pavement of close polygonal flat-topped granules, numbering about 70 on the larger plates. Papulae are widespread except close to the superomarginals and in interradial bands.

The madreporite is triangular with two angles truncated to form an irregular pentagon. It lies at about one-third r from the centre.

The superomarginal plates number only four in each series (i.e. eight on each of the five sides) with the exception of one series where a short extra plate occurs between the second and third. In some of the other series at this same position a triangular abactinal plate is partially inserted between these two marginals, possibly reinforcing this vulnerable area. The two inner superomarginals are elongated tangentially, rectangular in outline and slightly raised at the joints, though in general with a part-cylindrical section. The third plate is abruptly enlarged and swollen, extended radially to meet its fellow; together with the two smaller fourth superomarginals of each ray these make the upper side of a discrete broad rounded knob. The sutures between the third and fourth plates are oblique to the midradial line and the fourth plates are unequal in size so that the sutures are asymmetrical in all five cases.

The inferomarginals match the upper series in general but individual plates may be slightly misaligned; also there is an additional fifth plate in each series, bordering the small spout-like terminal plate. The third to fifth plates participate in the knob-like expansion of the tip. The more convex areas of the swollen marginals are mostly naked with only scattered granules over most of their surface and these sunk into sockets in the plates; only peripherally is the granulation continuous, as it

is on the first two (interradial) plates. The suture between the two marginal series is distinctly above the ambitus so that the inferomarginals are clearly visible from above but this may be due to contraction of the upper side during preservation.

The actinal plates in the distal halves of the rays form regular longitudinal series but proximally the arrangement becomes irregular because of the development and enlargement of interstitial plates. All the plates are fully covered with polygonal flat-topped granules distinctly coarser than the abactinal ones with the peripheral row discrete, even to the naked eye.

The adambulacral plates mostly bear five short blunt-tipped furrow spines, aligned vertically, sometimes four or (distally) six. These stand out slightly from the lower surface but are backed by several series of shorter 'spines' transitional to granules, all angular in section.

No pedicellariae can be distinguished.

AFFINITIES. This handsome goniasterid with its limited number of marginal plates has a considerable resemblance to those individuals of *Pentagonaster pulchellus* Gray, from temperate Australasia, with swollen arm tips (such as the holotype shown in Gray's pl. 8, fig. 3, 1866). *Pentagonaster* differs however in having the abactinal plates with only peripheral granules and their centres more or less markedly convex; also the individual marginal plates are rounded at the angles, not rectangular. There is also a remarkable resemblance to the Jurassic *Miopentagonaster calloviensis* Mercier in the very broad rounded arm tips, though again in that fossil species it is only the distalmost marginal of each series (together with the enlarged terminal plate in this case) that forms the expansion. The interradial marginals of *M. calloviensis* number only four on each of the five sides and appear rectangular in dorsal view, as in *S. mirabilis*.

However, judging from the great variation in the breadth of the arm tips in various goniasterid species such as *Pentagonaster pulchellus* and *Tosia australis* I think it likely that other specimens from the Amsterdam/St Paul area may prove to have more pointed arm tips. This is the case in the holotype of *Sphaeriodiscus scotocryptus* Fisher, 1913, from the Philippine Islands. It too has an almost complete granule covering, except on the centres of the marginal plates, a basically pentagonal form but for projecting tips to the rays and a limited number of marginal plates – in this case at R 32 mm five superomarginals with the three rectangular proximal ones of each series forming the sides of the body and the two distal ones contiguous midradially with their corresponding plates and forming the arm tip. Apart from these narrow arm tips and the additional marginal plate in each series at a smaller total size, *S. scotocryptus* differs from the new species in having seven to ten furrow spines on each plate, besides numerous pedicellariae, though this last may not be a specific character.

Of the other species of *Sphaeriodiscus*, the type species, *Sphaeriodiscus bourgeti* (Perrier, 1885) from off north-west Africa, also has four superomarginals but the first one is relatively short (tangentially) and the second is distinctly more swollen though not meeting its fellow midradially, the third plate is still convex but smaller than the second so that the outline is approximately pentagonal. The largest of Perrier's specimens had R 35 mm. H. L. Clark (1926) has recorded a specimen with R 27 mm

from off Natal in 420 m as *S. bourgeti*, expressing surprise about the extension of range to the south-east side of South Africa. The fourth superomarginals are only just beginning to appear and the arm tips are somewhat swollen, vertically if not horizontally, at least, judging from the measurements. He compared it with a syntype and with Perrier's figures and found no significant difference, so the Natal specimen presumably also has the second superomarginal distinctly larger and more swollen than the first, a condition also found by Madsen (1958) in a specimen of *S. bourgeti* from the Cape Verde area and difficult to reconcile with the close similarity of the first two marginals in *S. mirabilis*. Madsen compared *S. bourgeti* with a small specimen of *S. placenta* (Müller & Troschel, 1842), known from widespread localities in the Atlantic and Mediterranean, the main difference in the latter being the similarity of the consecutive superomarginals of which the fourth is already well developed. *S. placenta* is known to reach a size of nearly 90 mm R and at the same time to increase the number of marginals in each series to a maximum of nine superomarginals, though more often five to seven; two to five of the distal ones may be contiguous midradially and the arm tip may be broadened in some specimens as shown in Tortonese's fig. 72 (1965) of a Mediterranean example.

In the Pacific, *Sphaeriodiscus inaequalis* (Gray, 1847), supposedly from Amboina or New Guinea, has an even more diminutive first marginal in both upper and lower series than *S. bourgeti* in comparison with the second and third plates, which are markedly elevated with more or less tabulate raised areas, also on the corresponding inferomarginals, though at the same time the arms taper to a blunt point since the distal superomarginals are hardly at all expanded horizontally. At R only 21 mm, as in the holotype and only recorded specimen, there are only three or four superomarginals in each series. Owing probably to abrasion of the surface, this specimen does not show the characteristic 'peppered' appearance of the barer parts of the marginals of *Sphaeriodiscus* due to the recessed isolated granules, but this appearance is very conspicuous in Fisher's photograph (1906) of the holotype of *Sphaeriodiscus ammophilus*, from the Hawaiian Islands. At R only 24 mm this has but three superomarginals and the third is relatively small yet, though the first is hardly at all smaller than the second. The form is pentagonal.

LOCALITY. Unfortunately a small element of doubt exists concerning the type locality of *S. mirabilis*. Although the specimen came to Dr Arnaud together with invertebrates characteristic of the shelf in the vicinity of Amsterdam and St Paul Islands at 200–300 metres, the *Maria Martina* had also worked off South Africa and Réunion Islands. If it should prove that specimens of *Sphaeriodiscus* from Natal are conspecific with *S. mirabilis* rather than with *S. bourgeti* and no further material from these two remote islands is forthcoming, then the species may have to be deleted from their fauna.

Patiriella exigua (Lamarck, 1816)

Psterias exigua Lamarck, 1816 : 554.

Asterina exigua : Perrier, 1879 : 47.

Aatiriella exigua : Döderlein, 1927 : 296 ; Dartnall, 1971 : 40–43, pl. 4, fig. c.

MATERIAL. Amsterdam Island: mostly from the north side in the vicinity of La Roche Godon, under or on mid- or sub-littoral stones or in pools at low water, 60 specimens.

St Paul Island: from the crater, mostly the north-east part near the entrance, on or under sub-littoral or sometimes mid-littoral stones or from scrapings, usually with white or green algae, ascidians or sponges and often with *Amphipholis squamata* and *Amphiura capensis*, III specimens.

NOTES. Of the total of 171 specimens, two are four-rayed and two are six-rayed. Six out of 48 specimens from Beurois' station St Paul 8a (from the north-east part of the crater among lower mid-littoral and sub-littoral stones) appear more or less deformed, one having abnormally short rays and the interradii convex, making an ovate outline; the other five have one or sometimes two rays aborted or possibly regenerated, their other four (or three) rays aligned at right angles to each other. The smallest specimens have R c. 0.5 mm and three pairs of tube feet in each ray.

Spoladaster veneris (Perrier)

(Fig. 1; Pl. 3, figs 1, 2; Pl. 4, figs 1, 2; Pl. 5, figs 1, 2; Pl. 6)

Culcita veneris Perrier, 1879: 47-49, pl. 4; Mortensen, 1933: 249, 250; Arnaud & Beurois, 1972: 874 [Non *C. veneris*: Bell, 1905: 248.]

Spoladaster? veneris: Fisher, 1940: 136; A. M. Clark, 1952: 208.

MATERIAL. Amsterdam Island: off east coast at 'BMG', in lobster pot, depth unknown, possibly 10-50 metres, with gastropods *Ranella olearium* and *Charonia lampas pustulata*, 1 specimen; no details, 1 specimen; from washings of the large bryozoan *Turbicollopora redoutei*, sponges, gorgonians, the scleractinian coral *Caryophyllia profunda*, alcyonarians, etc. at 80-100 metres, 1 juvenile.

St Paul Island: off east coast in lobster pots, c. 300 metres, 3 specimens; north-west coast at La Chaussée du Phoques, 10-50 metres?, 2 specimens; near Roche Nord, in lobster pot, 1 specimen; various parts of the crater (the type locality) at 0.5-1.0 metre and in sublittoral scrapings, sometimes with the gastropods *Ranella* and *Charonia* and with echinoids, 5 specimens.

DESCRIPTION. A photograph of a live specimen (Pl. 6, fig. 1) shows a distinctly stellate form, R/r c. 1.8/1, whereas the preserved specimens all appear more nearly pentagonal with R/r 1.2-1.5/1. There must therefore be considerable contraction across the interradii marginally in preservation, possibly correlated with bending upwards of the arm tips, the resultant form having a close superficial resemblance to a *Culcita*. The collectors of Perrier's type material noted a considerable ability of the live animals to vary the shape of their outlines and degree of inflation of the upper side, which was also noted by the recent collectors. When inflated the whole appearance is said to be very like an orange, with which the bright colour of the upper side also agrees; the lower side is paler. In the live specimen photographed the madreporite shows up clearly about midway from the centre to the indented inter-radial edge but in preserved specimens it appears at a quarter to a third r from the centre. The enlargement of an arm in life (Pl. 6, fig. 2) shows a very 'shaggy' effect

produced by the extended papulae, which appear to arise all over the upper side except for narrow bands, notably in the interradii and in the centre, with only the slightest indication of grouping as in the meshes of a reticulum. In specimens preserved in alcohol the papulae are more or less retracted. A rough texture can be felt through the pustular skin, produced by numerous fine spinelets, which are invisible unless the specimen is partially or completely dried. These are isolated in the body wall, not based on skeletal plates. Indeed, X-radiography of an adult shows that the only abactinal plates of any density remaining are a few at the tips of the rays. The spinelets have the shape shown in Fig. 1(a). On the upper surface the spinelets are fairly evenly scattered but on the sides of the body they tend to become aligned in vertical series. At the junction of abactinal and actinal areas below the ambitus, where the papulae cease abruptly, this linear arrangement is even more marked and the pustular skin covering forms folds with narrow grooves between leading to the adambulacral furrows. Some of these series branch or anastomose.

In wet specimens there is usually a distinct change in the contours where the actinal and abactinal areas meet, with a slight horizontal ridge where one would expect to find the inferomarginal series of plates. Drying tends to emphasize this and may bring out a second apparently reinforced band just above. However, there is no trace of a separate intermarginal band of papulae, such as occurs in *Porania*. X-radiographs show no marginal plates at all (Pl. 5, figs 1, 2), nor do drying, dissolving the body wall or xylo treatment reveal any vestiges of marginal plates, even viewing from the inside of the body wall (Pl. 3, fig. 1), except at the tips of the rays. The external change in contours must therefore be due to reinforcing bands of connective or muscle tissue.

The actinal spinelets are similar in form to the abactinal ones and are similarly isolated in the body wall. The X-radiographs taken fail to show up any actinal plates but special treatment or viewing from inside reveals that in each V-shaped interradiial area adjoining the oral plates and the proximal adambulacrals is a small triangular patch of hollow, extremely thin-walled, rounded actinal plates (Fig. 1c). More distally there are traces of two, possibly three, partial series of plates running parallel to the inferomarginal series but these are not complete interradially in any of the areas treated and usually only the youngest plates adjoining the adambulacral plates are at all distinct. Presumably these actinal plates are progressively reduced during growth. None of these vestigial plates bear any enlarged spinelets or spines.

The adradial ends of the actinal pustular folds envelop the subambulacral spines as well; these number two on one or two proximal plates but one on the rest. There are two separately sheathed spines bordering the furrow on most plates. The oral plates usually have four furrow spines and one larger subambulacral spine, though larger specimens, R 60+ mm, may have two.

The juvenile specimen (Fig. 1g, h) has R/r 1.5/1.3 mm (excluding the length of the marginal fringe of spinelets). The margin is formed entirely by the relatively large inferomarginal plates, four on each of the five sides, and the terminal plates. The adjacent plates dorsally (presumably superomarginals) are markedly convex at their outer edges. There are two midradial plates on each ray and a ring of five larger primary interradiial plates around a small central area including the anus. All these

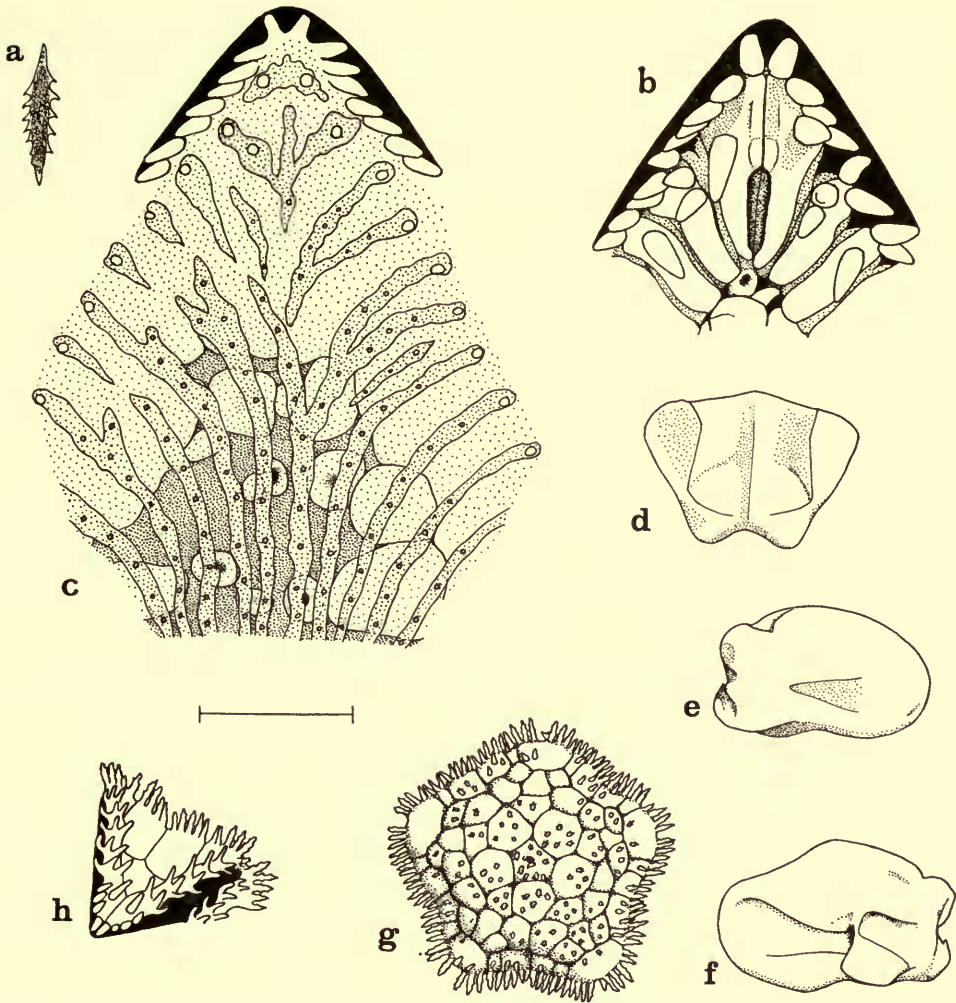


FIG. 1. *Spoladaster veneris* (Perrier). (a-f) St. AMS-104. R c. 55 mm. (a) Abactinal spinelet. (b) Jaw and adjacent four adambulacral plates, denuded except for major spines. (c) Proximal apex of one ventral interradius partly dried and cleared with xylene to show pustular folds (somewhat shrunken) with isolated spinelets and underlying reduced actinal plates. (d) Odontophore, viewed ventrally. (e, f) An isolated proximal adambulacral plate from the left side of a ray in aboral and adoral views, the furrow spines arose opposite the letter 'f' (g, h) St. AMS-96. Juvenile partly dried (some abactinal spinelets probably lost). (The scale equals c. 1 mm for a, c. 4 mm for b and c, c. 3 mm for d-f and 2 mm for g and h.)

plates bear spaced rugose spinelets, mostly about three times as long as broad and slightly waisted. On the inferomarginals the spinelets graduate to the horizontal fringe of spinelets bordering the entire animal, which is interrupted only at the distal ends of the furrows. The ventral side is quite flat. The inferomarginals are completely naked ventrally and the two first ones in each interradius cover most of the

interradial area together with the single actinal plate proximal to them. Two of the five actinal plates bear a single median distal spinelet but the other three are completely bare. There are six pairs of podia in each ray. Except for the first plate, the adambulacrals bear three spines in a more or less straight line at right angles to the furrow. The first plates may have four spines, the second one aligned obliquely to the first and clearly potentially a furrow spine. Presumably during further growth the second spine on the succeeding plates also shifts to the furrow edge of the plate. The oral plates already have four furrow spines and one suboral, as in most adults.

The general appearance of this specimen is remarkably like the holotype of *Marginaster fimbriatus* Sladen, 1889, as shown in Sladen's pl. 58, figs 4-6; that has R 6 mm and was collected to the north of Ireland. According to Ludwig it is conspecific with *Marginaster capreensis* from the Mediterranean but I consider that its affinities are much more likely to be with *Poraniomorpha*. The only difference between *M. fimbriatus* and this juvenile from the Indian Ocean is the development of a second row of actinal plates, which would be expected at the larger size.

There is no question that this small specimen could be a young *Patiriella exigua* since there are examples of that species of comparable size and they show a much more granuliform armament, with single shorter adambulacrals spines. Also the contours are quite different, the abactinal side rising vertically above the relatively smaller and more numerous inferomarginal plates.

GENERIC POSITION. Perrier described this species as belonging to a separate section of the genus *Culcita* (now included in the tropical shallow-water family Oreasteridae of the order Valvatida), this section being characterized by the fleshy body wall concealing the skeleton. He also noted affinities with *Asteropsis* (currently aligned near the Poraniidae in the order Spinulosida).

In 1905 Bell identified a fleshy pentagonal South African asteroid as *Culcita veneris* but Mortensen (1933) referred this specimen to *Cryaster brachyactis* H. L. Clark, 1923, also from South Africa. At the same time Mortensen pointed out that *Culcita veneris* is not a *Culcita* but probably belongs to the Asteropidae or perhaps the Cryasteridae, though in a footnote he doubts the distinction of these two nominal families.

In 1940 Fisher demonstrated that *Cryaster antarcticus* Koehler, 1906, the type-species of that genus, is congeneric with *Perknaster fuscus* Sladen, 1889 and so referable to the family Ganeriidae. However, he recognized that this affiliation does not extend to *Cryaster brachyactis*, for which he established a new nominal genus *Spoladaster*, referring it to the Asteropidae 'in the vicinity of *Tylaster*'. On the strength of Mortensen's comments, Fisher noted that *Culcita veneris* can probably also be referred to *Spoladaster*, an idea shared by me in 1952, when I suggested also that the South African *Tylaster meridionalis* Mortensen, 1933 might be based on smaller specimens of *Spoladaster brachyactis*. If this last premise proves true, then the problem is whether the species from South Africa and from Amsterdam and St Paul Islands are congeneric with *Tylaster willei* Danielssen & Koren, 1881, from the deep Norwegian Sea, this being the type species of *Tylaster*.

More immediately there is still a possibility that specimens from Amsterdam and St Paul Islands could be conspecific with those from South Africa, in spite of

Mortensen's denial of this (probably without seeing specimens from the islands). Zoogeographically this would be quite likely in view of the fact that *Patiriella exigua*, one of the two other asteroids known from these isolated islands, is also found in southern Africa, though it occurs also in temperate Australia. In addition, at least two species of ophiuroids, as well as the cosmopolitan *Amphipholis squamata*, are here recorded as common to this island group and to either South Africa or southern Mozambique.

However, the specimen of *Spoladaster brachyactis* in the British Museum collections from False Bay shows a distinct grouping of abactinal papulae in the meshes of an irregular reticulum, as described by H. L. Clark in the holotype. Also there is a separate horizontal band of papulae laterally in what should be the intermarginal area (Pl. 3, fig. 3, top). H. L. Clark describes 'innumerable minute' abactinal plates bearing the spinelets in the holotype, though Fisher found in the paratype that abactinal plates of any sort are only present at the arm tips and I am unable to find such plates in the general abactinal body wall either. H. L. Clark also describes a series of 'rather large plates buried in the skin' between abactinal and actinal areas, i.e. inferomarginal plates, while Fisher found that the paratype has 'fairly large phanerozonid inferomarginal plates imbedded in the leather body wall'. However, the X-radiograph taken of the British Museum specimen shows no trace of any marginal plates (Pl. 5, fig. 3), though the external view (Pl. 4, fig. 3) shows that some short inferomarginal spines are present. Unfortunately this is the only South African specimen now in the British Museum collections and I hesitate to mutilate it further to ascertain if any rudiments of marginal or actinal plates, as described by Fisher, are visible on the inside of the body wall. In Mortensen's smaller holotype of *Tylaster meridionalis* from South Africa with R 28 mm there is a continuous marginal fringe of short spines, with a parallel series of a few similar actinal spines close by on the distal part of each actinal area mid-interradially. In another specimen (presumably of similar or smaller size since it was not selected as holotype) which he dried, Mortensen made visible three or four irregular series of actinal plates. The Cape Town University specimen with R c. 80 mm which I referred to *Spoladaster brachyactis* in 1952 has numerous actinal spines, which would be much coarser than the microscopical actinal spinelets of the Amsterdam/St Paul material. Finally, the adambulacral plates of *S. brachyactis* (and of *Tylaster meridionalis* - if distinct) bear only one furrow spine apart from the subambulacral spine, whereas the Amsterdam/St Paul specimens have two furrow spines. I have no doubt therefore that the latter specimens are specifically distinct, so that *S. veneris* is a species endemic to the islands.

The differences can be summed up as follows :

<i>Spoladaster veneris</i>	<i>Spoladaster brachyactis</i>
No separate intermarginal band of papulae laterally	An intermarginal band of papulae distinct
No enlarged spines at the junction of the abactinal and actinal areas, nor on the actinal areas	Some inferomarginal spines usually present and in smaller specimens (R c. 35 mm) also some actinal spines
Two furrow spines on most adambulacral plates	Furrow spines usually single

The problem remains as to whether or not these two species should be regarded as congeneric with one of the northern hemisphere genera such as *Tylaster* or *Poraniomorpha*, both of Danielssen & Koren, 1881.

Unfortunately only a single young specimen of *Tylaster williei* is in the British Museum collections. This is the smaller specimen from Norwegian North Atlantic Expedition station 200 (71°25'N; 15°41'E, 1134 metres). It has R only *c.* 12 mm. The triangular arms are curled up dorsally but the form is markedly stellate rather than pentagonal. There are prominent inferomarginal and actinal spines similar in size to the adambulacral spines. The species was very well described by Danielssen & Koren in 1884 (pp. 64-67, pl. 11, figs 1-6), presumably on the basis of the single larger specimen, which was from the same station as this one. R is given as 40 mm and R/r can be calculated as 1.6/1, the form again being markedly stellate. Drying of the dorsal body wall revealed numerous isolated spinelets, described as needle-like but appearing to be quite capitate in their pl. 11, fig. 3. Viewing the body wall from the inside showed a horizontal series of rudimentary isolated lateral plates which were assumed to be the supermarginals and below these three series of more regular small plates linked by connective tissue, also approximately horizontal, the upper one of the three being taken for the inferomarginals and bearing externally a horizontal series of marginal spines in groups of usually three corresponding to the plates. Many of the actinal plates also bear similar but single spines forming several series, while there are some scattered additional proximal actinal spines.

Tylaster williei thus seems intermediate in form and skeletal development between the *Spoladaster* spp. and the wide-ranging genus *Porania*, the latter having a usually stellate form and an articulated skeleton.

Not surprisingly, the Amsterdam/St Paul species is remarkably similar to some North Atlantic pentagonal cushion-like specimens which were likewise ascribed to *Culcita* under the name *Culcita borealis* Sussbach & Breckner, 1911, from the area of the Shetlands, which name Farran (1913) also gave to some specimens from the west of Ireland. In 1914 Verrill established a new nominal genus *Culcitopsis* for *C. borealis*, pointing out that its affinities are with *Tylaster* and *Chondraster* of the family Poraniidae (which he kept distinct from the Asteropidae).

Östergren (1904), Grieg (1907) and Koehler (1909) emphasized that *Poraniomorpha hispida* (M. Sars in G. O. Sars, 1872) is a very variable species, Koehler including records from both sides of the Atlantic in his lengthy synonymy. In 1927 Grieg referred *Culcitopsis borealis* to the synonymy of *P. hispida* and Mortensen (1927) agreed that 'there is hardly any doubt' this is correct. Most subsequent workers have accepted Mortensen's judgement so that the synonymy of this species includes the following:

- Goniaster hispida* M. Sars in G. O. Sars, 1872: 28 (R of the holotype 11 mm): Storm, 1881: 90.
Asterina borealis Verrill, 1878: 213 (R 12 mm).
Porania spinulosa Verrill, 1879: 202 (R 40 mm).
Poraniomorpha rosea Danielssen & Koren, 1881: 189 (R *c.* 27 mm, judging from the scale of the figures).
Rhegaster murrayi Sladen, 1883: 156; 1889: 368 (R 14.3 mm).
Lasiaster villosus Sladen, 1889: 372 (R 10.5 mm).

Poraniomorpha hispida: Östergren, 1904: 615; Koehler, 1909: 100; Grieg, 1927: 129 (with forma *borealis* Sussbach & Breckner); Mortensen, 1927: 92.

Poraniomorpha (Lasiaster) hispida: Grieg, 1907: 40.

Culcita borealis Sussbach & Breckner, 1911: 217 (R 40 mm); Farran, 1913: 15.

Poraniomorpha villosa: Farran, 1913: 17.

Culcitopsis borealis (Sussbach & Breckner) Verrill, 1914: 21.

Rhegaster borealis (Verrill) Verrill, 1914: 17.

As shown by the R measurements for the holotype of each nominal species included above, most of them are based on relatively small specimens, the exceptions being *Porania spinulosa*, *Poraniomorpha rosea* and *Culcita borealis*. This is very unfortunate since small specimens of poraniids may give an exaggerated impression of the extent of skeletal development in the adult, as the evidence suggests there is often a tendency for progressive resorption with growth. It is significant that there are several other North Atlantic poraniids with markedly reduced skeletons, namely *Chondraster grandis* (Verrill, 1879), *Chondraster hermanni* Madsen, 1959 (treated as a subgenus of *Porania*), *Pseudoporania stormi* Dons, 1936, *Sphaeraster berthae* and *Sphaeraster björlykkei* Dons, 1938 – the last nominal genus preoccupied and subsequently renamed *Sphaeriaster* by Dons, all based on relatively huge specimens with R at least 80 mm and often 100 mm or even more. Madsen (1959) considers that all these are congeneric. I believe that their large size is responsible at least in part for their very reduced skeletons. The X-radiographs given by Dons and Madsen indicate that their material completely lacks abactinal and actinal plates of any substance and only Dons' *Pseudoporania stormi* has vestiges of supero- and inferomarginal plates.

The holotype of *Poraniomorpha hispida* is described as pentagonal in form, R/r 1.2/1, flat below and convex above, with both marginal series of plates distinct (probably by their contours). It came from the Lofoten Islands, off northern Norway. A larger specimen, R 40 mm, from Trondheim Fjord further south, presented to the British Museum by Storm, agrees well with this description (Pl. 3, fig. 4; Pl. 4, fig. 4; Pl. 5, fig. 4). It was X-radiographed for comparison with *Spoladaster brachyactis* and *S. veneris*, revealing very well-developed series of block-like supero- and inferomarginal plates outlining what appears to be an almost continuous pavement of slightly spaced plates, apparently mainly actinal plates but probably also some superimposed abactinals. In contrast, a cushion-like specimen in the British Museum collections, from the warm area of the Faeroe Channel, halved and dried (Pl. 4, fig. 5) shows only vestigial microscopic abactinal platelets on the inside of the body wall, small isolated superomarginals barely distinguishable interradially, slightly less reduced but still discontinuous inferomarginals and two well-separated series of isolated actinal plates with a group of additional proximal ones in each area. The inferomarginals and actinals are clearly in process of resorption, most of them being crescentiform or ring-shaped.

This degree of skeletal reduction approximates to that shown by *Spoladaster* and at the same time makes it difficult to regard *C. borealis* as conspecific with well-calcified specimens of *Poraniomorpha hispida* such as the one from Trondheim Fjord. Although he did not mention *Poraniomorpha* in his 1959 paper, Madsen's remarks on

the variations of the northern *Porania pulvillus* suggest that the distinction between that and *Poraniomorpha* is by no means sharp and needs further study, especially of growth changes. Until this can be done for the northern poraniids and the various taxa can be redefined, it seems unwise to alter further the nomenclature of these two southern species, which I accordingly propose to leave under the name of *Spoladaster*.

OPHIUROIDEA

Amphipholis squamata (Delle Chiaje, 1829)

Asterias squamata Delle Chiaje, 1829 : 74, 77, figs 1-4.

Amphipholis minor : Hertz, 1927 : 35.

Amphipholis squamata : Mortensen, 1933 : 364-365.

MATERIAL. Amsterdam Island : mostly from mid- to sub-littoral, in algae or coralligenous substrates or rock pools from various parts of the shore, some from grab hauls off the east coast down to 80 metres, others from stomachs of fishes such as *Acantholatris monodactylus*, 135 specimens.

St Paul Island : from washings of algae and *Laminaria* roots, east coast towards Roche Quille, 3-4 metres, 24 specimens ; washed from *Macrocystis* roots, 62 specimens ; from various parts of the crater, mostly under sublittoral stones or in washings from sponges, algae, bryozoa, compound ascidians, etc., 150 specimens.

Sea-mount south-east of St Paul Island : with compound ascidians, the scleractinian coral *Caryophyllia profunda* and bryozoa at 120 metres, 1 specimen.

NOTES. Most of these specimens are very small and in poor condition. Some were mixed with *Amphiura capensis* and also with young *Patiriella exigua*.

Mortensen has already pointed out that the *Amphipholis* from St Paul Island crater recorded by Hertz are not distinguishable from *A. squamata*, the only cosmopolitan echinoderm.

Amphiura capensis Ljungman, 1867

Amphiura capensis Ljungman, 1867 : 320 ; Mortensen, 1933 : 348-350.

MATERIAL. Amsterdam Island : washed from coralligenous bottom at 35 metres, north-east coast, 1 specimen ; from stranded laminarians, near La Cale, north coast, 3 specimens.

St Paul Island : from *Macrocystis* and *Laminaria* roots, 23 specimens ; from various parts of the crater, usually under sublittoral stones, 29 specimens.

NOTES. Most of the specimens from the crater of St Paul Island were taken with *Amphipholis squamata* and some also with young *Patiriella exigua*. All are small, the disc diameter not exceeding 4 mm. The arm spines number up to five proximally and are markedly flattened and spatulate. Some specimens have the disc scaling deficient near the oral shields, as shown also in many South African specimens.

This species is easily distinguished from *Amphipholis squamata* by the radial shields being only contiguous distally, the arm spines being more numerous and a different shape and the distal oral papillae and tentacle scales being single.

These records represent an extension of range from southern Africa, where *Amphiura capensis* is known from Luderitz Bay to Natal.

Amphiura sp.

MATERIAL. St Paul Island : on coarse sandy bottom with *Venus* at 50–80 metres off the north-east coast, 4 specimens.

Sea-mount south-east of St Paul Island : with compound ascidians, *Caryophyllia* and bryozoa at 120 metres, 2 specimens.

NOTES. Unfortunately all these specimens are in poor condition. The disc was probably fully scaled, the radial shields about a third as long as the disc radius and contiguous for their distal third, inwardly divergent. The oral shields are as long as broad or slightly longer, with the distal lobe shorter than the proximal angle. The distal oral papilla is blunt. The dorsal arm plates are fan-shaped. There are four tapering but blunt-tipped arm spines. The tentacle scales mostly number two but one specimen has more pores with only a single small scale. None of these characters are particularly distinctive.

This species does not agree with any so far recorded from southern Africa, judging from these specimens.

Ophiactis sp. probably *O. savignyi* Müller & Troschel, 1842

MATERIAL. Amsterdam Island : dredged on consolidated bottom at 40–50 metres off north coast, 1 specimen.

St Paul Island : washed from various coralligenous encrusting organisms, compound ascidians, *Caryophyllia*, bryozoa, etc. at 60–80 metres off the north-east coast, 1 specimen.

NOTES. Both specimens are fissiparous with six arms ; one has three arms larger and three regenerating, the other has two and four.

Even the larger specimen has the disc diameter only just exceeding 1 mm. The disc scales are relatively coarse at this small size and the proportions of the radial shields not obvious – partly due to the regeneration. One specimen has disc spines, the other has not. Some of the jaws have two distal oral papillae on at least one side, elsewhere there is only one distinct papilla. The dorsal arm plates are fan-shaped but the distal curve is flattened medially. There are four rugose arm spines, all but the uppermost one truncated.

The occurrence of two distal oral papillae in some cases and the shape of the arm spines make it almost certain that these two small specimens are referable to the 'tropicopolitan' *Ophiactis savignyi*, which ranges down the coast of East Africa to Natal.

Ophiocoma pusilla (Brock, 1888)

Ophiomastix pusilla Brock, 1888 : 499.

Ophiocoma pusilla : Devaney, 1970 : 25–28.

MATERIAL. Amsterdam Island : on consolidated bottom at 40–50 metres off the north coast, 1 specimen.

Sea-mount south-east of St Paul Island : with compound ascidians, *Caryophyllia* and bryozoa at 120 metres, 10 specimens.

NOTES. The largest specimen has disc diameter 7.5 mm and is the only one to show the swollen-tipped arm spines on a few segments beyond the arm bases so characteristic of this diminutive species of *Ophiocoma*.

The granulation of the disc distinguishes this from any of the other species recorded from these two islands.

Ophiocoma pusilla is known from isolated records throughout the tropical Indo-West Pacific, as far south in East Africa as Inhaca, southern Mozambique. It is usually found in coral heads, mostly in shallow water but possibly down to just over 100 metres. Because of its furtive habits and likelihood of confusion with other species of *Ophiocoma*, it may well have been overlooked at greater depths.

One of the two localities at which this species was collected is common to the *Ophiactis* discussed above. If this really is *Ophiactis savignyi*, as seems very likely, then the extension of range to Amsterdam and St Paul Islands of another tropical reef species is not surprising.

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